

A Brief History of Shipbuilding in Recent Times

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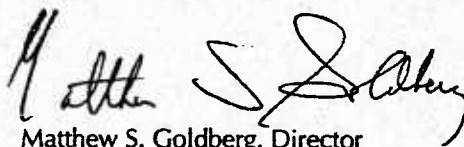


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A handwritten signature in black ink, appearing to read "Matthew S. Goldberg". The signature is stylized with a large initial "M" and a long, sweeping underline.

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The condition of U.S. shipbuilding

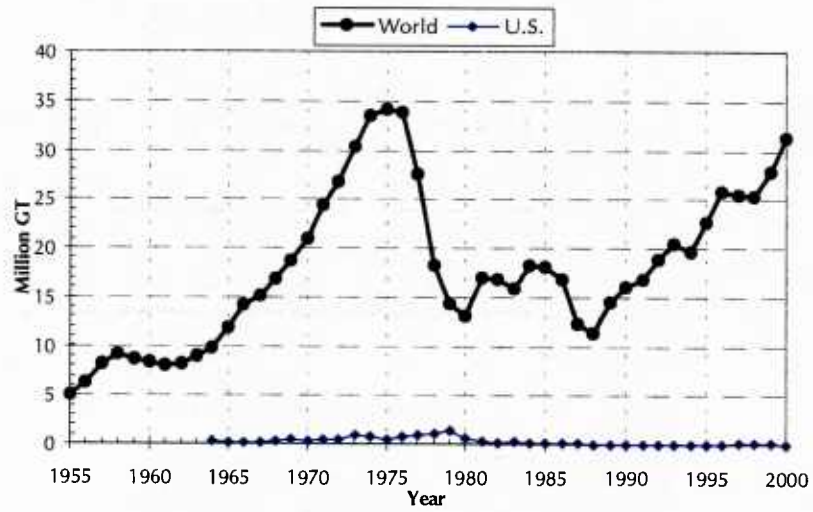
U.S. shipbuilding has been examined repeatedly in recent years with general agreement about the major findings [1] [2]. From the shipbuilders' perspective, the major problem is that too few large ships are being ordered and built; and from the perspective of buyers, the major problem is that large U.S. built ships cost too much. There is no consensus, however, about what can, or should, be done about the major problems nor about the relative importance of many related issues. This study traces the effects of important recent events leading to the current situation.

Several characteristics of ships and shipbuilding give continuing importance to past events. Because modern ships have an economic life of about 30 years, some of the factors affecting the current market are echoes from past events. And other factors that affect the current market are based on expectations about what is likely to happen in the next 30 years. Such factors in turn cause echoes because future events are often based on what happened in the past. Another reason past events continue to have influence is that large numbers of skilled workers and costly facilities are required for ship construction. Coordinating efficient use of the facilities and effective use of the work force is always complicated and challenging; and interruptions are almost impossible to accommodate because an efficient shipyard and effective labor force can't be maintained without building ships. Starting new shipbuilding operations, or significantly increasing the scale of existing operations, requires complicated planning and years of investment. In addition, prospective changes in shipbuilding often become political issues. They become political issues because they influence the economic health of regions and because ships are important in warfare, both as warfighting platforms and for transporting cargo. These complicating factors make changes controversial so they tend to be contemplated and argued for years and implemented slowly and partially. This becomes another connection with the past.

Because the condition of U.S. shipbuilding has roots in history, tracing the recent history helps us explain and understand the current condition. Our summary covers the last 60 years. We focus on four historical events that had major impact on shipbuilding: World War II, the Suez Crisis in 1956, the OPEC oil embargo in 1973, and the end of the Cold War in 1989. Although in some ways the shipbuilding industry in the United States has become isolated from the world market, we trace the history of the world shipbuilding industry for several reasons. One is that tracing developments in world shipbuilding provides a proper context for considering U.S. shipbuilding. Another reason is that U.S. shipbuilding was once more a part of the world market than it is now and may need to become so again. We are interested in both commercial and navy ships. Although commercial and navy ships are very different and at any point in time it may seem that navy shipbuilders and merchant shipbuilders are two distinct groups, most naval shipbuilders have built merchant ships, and many, if not most merchant shipbuilders have also built naval ships.

The history of the shipbuilding industry in the years since World War II has been one of boom and bust as shown in figure 1. Most of the world's merchant ships are now built by Korea and Japan, which together built about 77 percent of the gross tonnage delivered in 2000. The third-ranked shipbuilding nation in 2000 was China, which built almost 5 percent of the world output. Several European countries are small but significant participants in the world commercial shipbuilding market. Listed in order of total gross tonnage of ship deliveries in 2000, from largest to smallest, these countries are Germany, Italy, Spain, Denmark, the Netherlands, Finland, France, Norway, the U.K., and Sweden. Together, they produced about 10.5 percent of the gross tonnage of merchant ships delivered in 2000. U.S. shipbuilders produced less than one-fourth of one percent of the commercial tonnage delivered in 2000, which is about the same as the production from Finland [3].

Figure 1. World and U.S. merchant ship deliveries



From World War II to the Suez Crisis (1946–1956)

Ships may never again be as important as they were in World War II. For the war in Europe, merchant ships performed a critical role by carrying forces and equipment, and support across the Atlantic to beleaguered Britain. The war in the Pacific was even more naval in character. Both the United States and Japan needed to move long distances across the ocean. Because ship-borne support was crucial for the Allies in Europe, Germany focused on interdicting allied shipping and devoted great effort to building warships for the battle of the Atlantic. Submarines were particularly effective and became their principal weapon. The Allies needed to replace losses of merchant ships and build warships to combat the U-boat threat. Before the war, the international maritime industry was dominated by the four nations that became the war's main protagonists; and because ships were so important, considerable effort and resources were devoted to designing and building ships during the war. Many important innovations and advances in shipbuilding were discovered and developed during that time.

After the war, the triumphant United States and UK were left with large fleets, both navy and commercial, and very large shipbuilding industries. The United States had 8 naval shipyards and at least 64 private-sector shipyards that were actively building large naval or merchant ships. Of the 64 private-sector yards, 24 had been major shipbuilders before the war, 20 had been established or expanded by the Navy for the naval shipbuilding program, and 20 had been established or expanded by the U.S. Maritime Commission for the merchant shipbuilding program [4]. The geographic concentration of the large British shipyards in the extreme north of England and in Scotland had protected their shipbuilding industry from the worst of the bombing, and relatively little reconstruction was required.

However, most of the U.S. and U.K. shipyards were modeled on the labor-intensive practices of the 1920s and 1930s.

When the war ended, the United States had many more ships than it needed and a shipbuilding industry sized to build at wartime rates. The U.S. government sold large numbers of surplus Liberty and Victory ships to other nations at relatively low prices. But such ships were not appropriate for some uses so there was a large and growing demand for new ships, particularly tankers, as world trade expanded and merchant fleets were re-established. Most of the demand for new ships was in Europe. British shipbuilders had the advantage of location as well as available functioning shipyards. The early years of the period, from 1946 to 1956, were years of growth and prosperity for British shipbuilders who thrived on the reconstruction of the world's merchant fleets with little competition from other regions. In the immediate post-war years, British shipyards produced almost half of all the new merchant tonnage built worldwide.

In continental Europe and in Japan, shipyards had been important targets for allied bombing and when the war ended, the shipbuilding industries lay in ruins. Most of the ships belonging to European nations and Japan had also been destroyed. By the 1950s, three significant trends were beginning to appear, all of which were at first ignored by the established shipyards, to their subsequent great cost:

- First, the countries whose shipyards had been badly damaged by the war—principally Japan, Germany, France, and Italy—were able to build new facilities or rebuild old facilities that were much more efficient than those they had lost. When these revitalized shipyards started to come on stream, the older shipyards, particularly those in Britain, were suddenly at a competitive disadvantage, not only in terms of cost but also of delivery.
- Second, a number of European nations that had not been major shipbuilders in the past began to invest in the facilities needed to share in the prosperity. These countries included the four Scandinavian countries—Norway, Sweden, Denmark, and Finland—as well as three less developed Mediterranean countries—Spain, Yugoslavia, and Greece. As a result, the

geographic distribution of the world market was significantly different by the end of the period and was changing yearly.

- Third, and by far the most significant, the reconstruction of the Japanese economy after World War II led directly to the emergence of the Japanese shipbuilding industry as a world power. This should have been no surprise to the western world, since the Japanese industry had grown considerably during the war and had demonstrated its potential by constructing many types of ships in a wide range of sizes for the Imperial Japanese Navy.

An American named D.K. Ludwig provided the spark for the post-war recovery in Japanese shipbuilding. His shipping company, National Bulk Carriers, (NBC), leased the shipyard in Kure that had built the great Japanese battleships and started the construction of tankers that were much larger than the current world standard. At that time, Japan was almost the only country using large tankers because it imported nearly all of its oil and its tankers were not constrained in size by the limitations of the Suez Canal [5]. The NBC shipyard at Kure was the first shipyard to adapt the industrial engineering principles developed in the U.S. wartime economy. Its General Manager, Elmer Hann, had spent the war managing one of the most successful of Henry Kaiser's emergency shipyards. The large Japanese trading companies immediately saw the potential for large-scale assembly-line construction of ships, using standard designs and with individual shipyards specializing in only one or two designs. These concepts were quickly copied and developed, and by 1956, the Japanese industry overtook Britain to become the leading shipbuilding nation in terms of output.

During the post-war years, the Soviet-bloc countries also rebuilt their shipbuilding capacity, primarily in Poland and East Germany for commercial ships, and in the Soviet Union itself for naval vessels. To a great extent, Soviet-bloc shipbuilders built only for Soviet-bloc shipping companies and presented no threat to the western world because they were not required to be cost-competitive and their ships were of poor quality and not very reliable.

Elsewhere, the only significant shipbuilding activity was in Brazil, where in the 1950s, the Brazilian government encouraged existing

small shipbuilders to increase their capabilities and capacity. As a result, Brazil could be counted among the world's shipbuilding nations, although its markets were purely domestic.

In the United States, the trend was moving in a direction opposite to that of the rest of the world. After the war, the Navy shipyards immediately scaled back their operations but continued to be the primary source of Navy shipbuilding. No Navy shipyards were closed. All but two of the emergency yards that had been built specifically for the war effort were closed and disposed of, although several later re-emerged as ship repair facilities. The remaining private-sector shipyards also scaled back their operations, but unlike the Navy shipyards, they immediately began to suffer from lack of work. During this interval, several major shipyards that had been in operation prior to World War II closed, and several more ceased to be active shipbuilders and turned to ship repair. The only bright spot during this period was the worldwide increase in demand for petroleum, which led to the construction of 135 large tankers, all built by the old established yards at Bethlehem Sparrows Point (MD), Bethlehem Quincy (MA), Sun (PA), and Newport News (VA) [6].

By the end of 1950, the U.S. shipbuilding industry had almost no work and made an unsuccessful appeal to the Government to fund sufficient new shipbuilding to keep a minimum level of mobilization capability employed. The Korean War stimulated some activity, mostly in reactivation of the Reserve Fleet and in repair work, but no new ship construction was required. There were still many merchant ships in the Reserve Fleet, and the Navy had more than 1,000 ships. The "Mariner" program was funded in 1951, under which the U.S. Maritime Administration (MARAD) contracted with each of seven shipbuilders to build five cargo ships of a new and relatively adventurous design. MARAD sold 30 of these 35 ships to private-sector ship operators and the remaining 5 were assigned to the Navy. The Mariner program brought some life to the U.S. shipbuilding industry for a few years, but the period was one of overall decline and the industry continued to contract.

Just as the coming of peace brought the reconstruction of the world's merchant fleets, it also brought an end to naval shipbuilding. The

world's navies were scaled back everywhere, and naval shipbuilding almost came to a standstill.

The structure of the world fleet began to change during this period. Most cargo ships were still either war-built break-bulk ships or tankers, but the proportion of tankers was increasing and tankers were getting bigger. The average size of tankers was about 12,000 dead-weight tons (DWT) at the end of the war and about 16,000 DWT in 1956. In 1956, the largest tanker that could transit the Suez Canal ("Suezmax") was about 32,000 DWT, and the largest tanker in existence, built by National Bulk Carriers at Kure, was about 85,000 DWT.

From closure of the Suez Canal to the OPEC Crisis (1957–1973)

The closure of the Suez Canal in 1956 had a stunning effect on the tanker market. Suddenly, the flow of oil from the Persian Gulf to Western Europe and the United States had to be re-routed around the Cape of Good Hope, leading to an immediate shortage of oil and an overnight increase in the demand for tankers. Because tankers had to travel much longer distances, economies of scale associated with operating larger ships were magnified, and, at the same time, the size constraint imposed by the Suez Canal disappeared. The opportunity was not ignored. Not only did the tanker fleet grow by almost 400 percent during this period, but the average size of a tanker grew from 16,000 to 58,000 DWT. The largest tanker in the fleet grew from 85,000 to 550,000 DWT, the point where it remains today. The same economic considerations that had led to the success of large tankers and the demonstrated increase in profits from those tankers encouraged the use of much larger ships for dry bulk and other trades. Shipyards that could build these huge ships became the leaders in the industry.

The period from 1957 to 1973 was one of great change for shipbuilders. The structure of the industry changed dramatically, as the demand for ships shifted rapidly from general cargo ships to larger tankers and as more and more low-cost producers emerged in Japan and the less developed countries. Japan had edged Britain out of its position as the leading shipbuilding nation by 1956, but European shipbuilding as a whole was at that time still a major force. By 1973, however, the Japanese shipbuilding industry had displaced all Western European countries combined. The Europeans had not yet worked out where their shipbuilding future, if any, would lie and were still trying, unsuccessfully, to compete in the markets for large tankers and dry bulk carriers. Many British shipyards belatedly invested in facilities for building large tankers, but most went only half-way or

waited too long, constrained by their location, their bankers, and/or their imaginations. The successful European shipbuilders during this period were those with all-new rather than modernized facilities. These firms included Kockums, Eriksbergs, Gotaverken, and Oresunds in Sweden; Odense in Denmark; Wartsila in Finland; La Ciotat in France; and Astilleros de Cadiz in Spain. The old-line firms became even less able to compete.

The period from 1957 to 1973 was one of boom in Japan, where the shipbuilding industry grew significantly, increasing its output by a factor of more than ten—from about 5 million GT in 1957 to about 60 million GT in 1973. Japanese shipyards refined their production techniques during this period to the point that their productivity was more than double that of European and American yards, and their wages remained low. Sales managers offered only standard designs and fixed deliveries. The demand for ships, especially for large tankers, was so strong that the shipyards were making substantial profits, and ship owners were making money buying and selling contracts for new ships even before the keels had been laid. All this came to a halt in 1973, but the collapse in the industry's order books was not to follow for a few years because of the time needed to finish the ships under contract.

Because the large tanker is one of the simplest and most labor-intensive types of merchant ship to build, its dominance of new ship construction contracts between 1957 and 1973 fueled the development of shipbuilding in less developed countries. This trend was spurred by the fact that shipbuilding is a technology that is relatively easy to transfer and has the significant attractions of providing many jobs and generating hard currency. Along with Spain and Yugoslavia in Western Europe, Poland in Eastern Europe, and Taiwan in the Far East, the shipbuilding industry in Brazil continued to grow, particularly with investment from Japan's IHI and Holland's Verolme. Elsewhere, the Indian government invested in new facilities during this period, and Portugal, Bahrain, the U.A.E., and Singapore built large ship repair yards to cater to the new fleets of large tankers. Both Brazil and India subsidized their shipyards heavily, and their output was largely directed to building up their national-flag fleets.

At the beginning of this period, U.S. shipbuilding was still in the doldrums. Considerable relief was provided, however, when the Navy finally recognized that private-sector shipbuilders were 30 percent to 40 percent more efficient than government shipyards. The Navy closed its three shipyards in Boston, Brooklyn and San Francisco and ended all new ship construction work in Navy shipyards. The Navy then started a wholesale modernization of the fleet, and planned to build 250 new ships over the 5-year period between 1963 and 1967. This work gradually became more and more concentrated in a handful of private-sector shipyards [7].

The election of President Nixon in 1968 ushered in an era of major change for the commercial side of the U.S. industry. One of his first actions was to appoint a President's Commission on American Shipbuilding to study the industry and to make recommendations for change, as a result of which the Nixon Administration introduced a number of amendments to the Merchant Marine Act of 1936, the most significant of which extended the Act's provisions to include not only general cargo and passenger vessels but also tankers and dry bulk carriers. As a result, by the end of the period, the industry was as healthy as it had been at any time since the war. No one expressed reservations about the re-emergence of the former Brooklyn naval shipyard as a privately operated facility for the construction of large tankers or about the substantial sums being invested by existing shipbuilders in facilities for the construction of large tankers and liquefied natural gas carriers. Shipyards had so much commercial work that for several years at the end of this period, the Navy could not find enough interested shipbuilders to build all the ships for which funds had been appropriated [7].

A further feature of this period was the emergence of a wholly new sector of the industry, the construction of vessels for offshore exploration for oil and gas. This technology had its origin in Texas: The first shipyards to engage in this business were all located in Texas, and, at the height of the market, 80 percent of the world's drill rigs were built in Texas [6]. The early drilling rigs were barges, many of them conversions, and the early jack-ups were essentially barge hulls with legs. In the 1950s, wartime LSTs were converted to drilling tenders, and the first drill ships were also conversions. As a result, the

offshore sector of the shipbuilding industry was distinct from the traditional shipbuilders. The offshore yards were less capitalized and, although naval architects designed the rigs, the rig builders came from the oil industry rather than from shipbuilding. In the early 1960s, the industry had progressed to the point that wholly new and more complex designs of rigs were being built—jack-ups, semi-submersibles, and drill ships—with ever more impressive performance characteristics. In addition, other specialized offshore markets developed, such as heavy derrick barges and offshore service vessels. By the end of the period, at least six shipyards in Texas were wholly devoted to the construction of offshore drilling rigs.

Navy fleets from the World War II era were becoming obsolete during this period, and naval forces began to be extensively renewed. Because navy shipbuilding is a strategic capability, every major nation builds its own navy ships. Therefore, navy shipbuilding output was dominated by the four nations with important navies: the United States, the U.S.S.R., Britain, and France.

From the OPEC Crisis to the end of the Cold War (1974–1989)

Eighteen years after the closure of the Suez Canal had had such an impact on the industry, the OPEC oil embargo (announced October 25, 1973) and the resulting increase in the price of oil had a similarly dramatic effect, only in the opposite direction. Suddenly, the demand for oil collapsed and the need for tankers evaporated. The collapse in demand was so sudden and so severe that many new ships that were already under construction went straight from the shipbuilder into long-term lay-up in the fjords of Norway or the harbors of Greece and Southeast Asia, and a few went to the “breakers” without ever carrying a cargo.

With the bankruptcy of many ship owners and shipbuilders (and of some shipping banks as well), it soon became apparent that the only way European shipbuilders could stay in business and compete with Japan would be with the aid of government subsidies. Because shipbuilding is a large and politically sensitive industry, government intervention was employed almost everywhere. Some countries tried nationalization, while others opted for forced rationalization (reorganizations and mergers to eliminate duplication and over capacity), and the remainder offered financial supports on a case-by-case basis. After a few years, it was apparent that there was little hope of recovery, and ship production capacity began to be cut back everywhere. By 1989, the shipbuilding activity in Western Europe had sunk to its lowest level of the century. Every shipbuilding nation had been forced to support its shipyards financially, at great expense compared to the number of jobs maintained. Only the lowest-cost European producers—Yugoslavia and Spain—were able to hold any significant market share. Several countries abandoned the struggle altogether, most notably Sweden, which had only entered the industry in the post-war years and had invested heavily enough in facilities to achieve third place in the world rankings. Other countries tried different

approaches: Those that had tried rationalization first then tried nationalization, and vice versa. The European industry contracted to a few remaining shipyards that specialized in the more complex and technically sophisticated ship types such as warships and passenger liners, for which the price disadvantage with Japan and Korea was less significant. The newly developed shipbuilding industries of Brazil and India suffered in the collapse of demand and were only maintained, with government support, at low levels of production.

An interesting example is the country that had once dominated world shipbuilding. Britain initially tried forced rationalization, but the shipyards working in groups were no more competitive than before. It then tried nationalization, which didn't make them more competitive and was a bureaucratic nightmare with huge losses. Britain then tried privatization with targeted financial assistance; this did not work because the new companies were undercapitalized and the supports were inadequate. Finally, it cut away all the supports, as Norway and Sweden had done 15 years earlier, and the British shipbuilding industry withered to almost nothing.

The collapse in the demand for ships also affected the Japanese shipbuilding industry. By 1980, Japanese shipbuilding was cut back 35 percent, and the industry was radically reorganized into four groups, each containing a balanced mixture of yards, large and small, high-tech and low. Many of the relatively new tanker-building yards were closed permanently, and others converted to offshore fabrication or repair work. Further reductions in capacity followed, and the government began to tightly control the annual output of individual Japanese shipbuilders [8]. By 1989, the Japanese shipbuilding industry still dominated the world shipbuilding business, but the pie of which it had the largest slice was very much smaller than it had been in the 1970s.

South Korea entered the shipbuilding market during this period of collapsing demand, and its entry proved to be of enormous significance. The giant Hyundai group opened a state-of-the-art shipyard, developed with technical assistance from Britain, in Ulsan in 1973. Daewoo opened its shipyard operations in Okpo in 1978 and Samsung in Koje in 1979. Each of these facilities was designed to build the

largest sizes of tankers and was prepared for considerable expansion. With labor costs that were about one-fourth those of the Japanese, the Koreans were competitive with the Japanese even when they were less efficient. Korean shipbuilders offered to build at low prices and were soon taking an increasingly large share of the market. As the Koreans built more and more ships, their shipbuilding technology made remarkably rapid progress [9]. By 1989, three more Korean shipyards were in operation: one developed by Halla in Samho, another by Korea Shipbuilding in Pusan, and the third by Hyundai which converted its repair yard in Ulsan to new ship construction. By 1989, Korea's market share had grown to 24 percent as Japan's had declined to 38 percent. However, the Korean shipbuilding industry was not without troubles. Labor unrest made it apparent that Korean shipyard wages would have to be increased considerably in the years to come and that, while the Korean shipbuilders were building many ships, they were also getting into serious financial trouble.

Soviet-bloc shipyards were also in a growth mode during this period because the Soviet leaders had decided that a Soviet merchant marine trading worldwide would not only reduce the costs of imports but could also generate significant amounts of hard currency. By the end of the period the Soviet bloc's merchant marine had been overbuilt and it was apparent that there would be surplus shipbuilding capacity in this region.

Another significant development during the period was the emergence of the People's Republic of China as a shipbuilding nation. China had always had shipyards, but, like the U.S.S.R., it had concentrated on internal markets because it had never had an international merchant fleet. During this period, the Chinese government created the China Ocean Shipping Corporation (COSCO) to carry its increasing foreign trade, and the China State Shipbuilding Corporation (CSSC) to manage the activities of its shipyards and to develop an export shipbuilding business.

During this same period, Singapore emerged as another new player in the shipbuilding industry. At the beginning of the period, U.S. builders of offshore drilling rigs looked for lower-cost overseas facilities to help them meet the strong demand for new rigs and found

them in newly independent Singapore. By the end of the period, Singapore owned all of these facilities.

During this period, U.S. shipbuilding went from boom to bust. In the late 1970s, the industry was busier than it had been at any time since World War II, with 22 large shipyards building large numbers of cargo ships of all types for U.S.-flag foreign-trade operators, tankers, and container ships for Jones Act trade, drill rigs and supply boats for the offshore industry, and barges for the inland waterways. All this came to a halt in the early 1980s as a result of four almost simultaneous developments:

- One of President Reagan's first actions after he took office in January 1981 was to terminate all funding for Titles V, VI, and XI of the Merchant Marine Act. Title V provided subsidies for the construction of foreign-trade ships and Title VI for their operation, while Title XI allowed U.S. Government guarantees for the financing of U.S.-flag ships built in U.S. shipyards.
- The boom in the offshore oil and gas industry came to an end, drying up demand for new drill rigs and supply boats.
- Overbuilding of the inland fleet created by easily available financing caused defaults by several operators and brought an abrupt end to this market sector.
- Construction of the Alaskan-trade tanker fleet was completed, resulting in a collapse in demand for Jones Act shipbuilding.

The shipbuilding industry in the United States collapsed and, in the 5 years that followed, employment fell by a third, and the number of active shipyards was reduced by 40 percent. The volume of naval shipbuilding increased significantly during the same period as the Reagan Administration built up the nation's armed forces and set a goal of a 600-ship Navy. However, with no commercial work to fall back on, the competition for naval shipbuilding contracts was so desperate that it effectively drove at least three major long-established shipbuilders—General Dynamics (Quincy MA), Sun Shipbuilding (Chester PA), and Bethlehem Steel (Sparrows Point MD)—out of the business, leaving the work concentrated in only six shipyards, none of which were making any money from building merchant ships.

From the end of the Cold War to the present (1990–2002)

The downward trend in the international shipbuilding market experienced in the late 1970s and early 1980s hit bottom in 1987, almost exactly 30 years after the Suez Crisis touched off the previous upturn in the cycle. The level of shipbuilding orders turned upward in 1988 and that of deliveries in 1990. The primary reason for this change was the need to begin replacing the large tankers built in the late 1960s and the early 1970s, many of which had been built and/or maintained to standards that now made it relatively expensive for them to pass the particularly rigorous inspection associated with their fourth special survey, due at age 20.

Shipbuilders were optimistic that this requirement would lead to a new era of prosperity, especially when coupled with two other important factors:

- First, it was expected that new international and national legislation and regulation, driven largely by the *Exxon Valdez* oil spill in 1989, would hasten the replacement of tankers in particular and possibly many types of older ships as well.
- Second, it was hoped that the industry's considerable reductions in capacity over the preceding decade would so reduce the supply side of the supply/demand equation as to almost guarantee a seller's market in the decade ahead.

The anticipated increase in shipbuilding activity did, in fact, happen, although it did not come as quickly as was expected, and many expert projections had to be revised in later years, with the projections of demand shifting to later years each time. The uncertainty created by the 1990 Gulf War was the principal reason for the delay. In fact, it was not until 1993 that the recovery actually became apparent. In addition, expectations that capacity would be held constant (thus

forcing prices upward) have faded in the face of four opposing trends:

- The major Korean yards, seeing an opportunity, ignored pleas for restraint and added considerable new capacity.
- The Chinese shipbuilding industry similarly ignored pleas for restraint and continued to develop new capacity.
- The decline in demand for naval shipbuilding that resulted from the end of the Cold War allowed substantial naval shipbuilding capacity to be made available for commercial work, in the United States—notably at Kvaerner Philadelphia—and in the former Soviet Union—both in the St. Petersburg region and on the Black Sea.
- The privatization and modernization of obsolete and inefficient commercial shipbuilding facilities in the countries of the former Soviet Bloc—notably in Poland and East Germany—also effectively added new capacity.

By the turn of the century, worldwide production was increasing and was expected to continue in that direction for at least the next several years. The Japanese and Korean shipyards filled most of the growth in demand. The Korean industry had increased its share of the market to about 35 percent, finally overtaking the Japanese industry, which was barely holding its own at about 33 percent and losing money. The Western European market share was continuing to decline, despite their concentration on niche markets and continued use of subsidies. Rapid improvements in technology and productivity gains made by the Koreans were enabling them to deliver increasingly complex ships at lower prices than European shipbuilders. This was undermining the European philosophy of concentrating on niche markets. So while Western European shipyards still dominated the high-value markets for such ship types as cruise ships, large ferries, chemical carriers, roll-on/roll-off ships, and refrigerated-cargo ships their dominance was eroding.

Another feature of this period was the development of new shipbuilding capacity in Central and Eastern Europe:

- In the former East Germany, shipyards were acquired by Western European shipbuilders and extensively modernized and reorganized, effectively adding new capacity to the world scene at the taxpayers' expense.
- In Poland, although several major shipyards closed, others recovered through their own efforts and, like the East German shipyards, effectively became new capacity.
- Navy shipyards on the Baltic and the Black Sea regions of the former Soviet Union began pursuing fabrication work from the West, effectively adding still more capacity to the world scene.
- Finally, the Croatian shipbuilding industry, which had been a major player before the disintegration of Yugoslavia, was privatized and, with private-sector help from Western Europe, began to recover.

Some form of government support for shipyards has become accepted as "normal" throughout most of the world. As a result, shipbuilders have shifted some of their focus from competition with other shipbuilders to political efforts to increase government support. The United States instigated multilateral negotiations toward an agreement with other shipbuilding nations that was to eliminate all subsidies so that shipyards could compete on a "level playing field." The negotiations were conducted in 1984 by a working group of the Organization for Economic Cooperation and Development (OECD) working group that included Korea. Although U.S. and European shipbuilders initially expressed support for the proposition, in principle, they became concerned that their governments had agreed too hastily and that they could not survive competition with the Far East shipbuilding industries without subsidies. The agreement was finally ratified by every signatory nation except the United States, where Congress called for a modified version with more protection for U.S. shipyards. As a result, the agreement was not implemented, and many European nations subsequently increased the level of subsidies made available to their shipbuilders.

In the United States during this period, the shipbuilding industry succeeded in recovering from the disastrous Reagan years. Post-Cold War reductions in defense budgets and in the size of the U.S. Navy

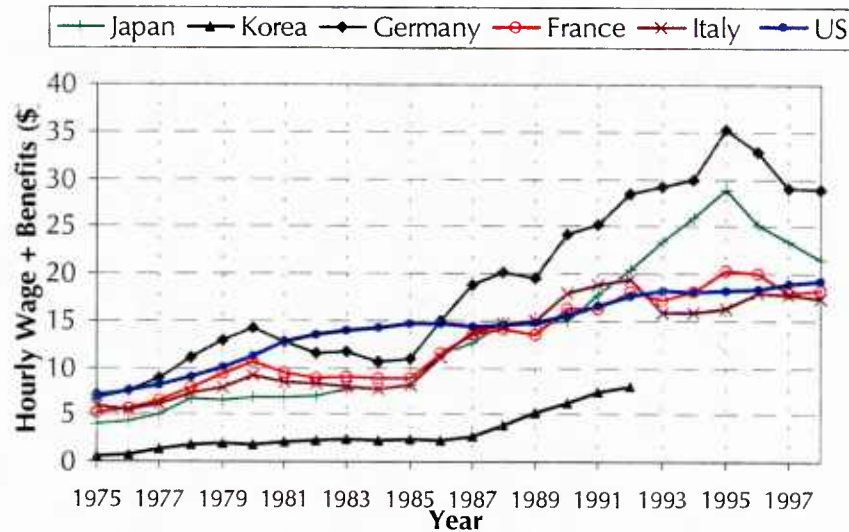
made concerns about maintaining shipbuilding infrastructure increasingly important and maintaining meaningful competition more difficult. Through mergers and buy-outs, all the major shipyards came to be owned by one of two major defense corporations, and the Navy's major programs were structured to effectively eliminate all but a pretense of competition. Although U.S. builders of large ships are effectively priced out of the world market for merchant ships, the "Big Six" shipbuilders are highly profitable, with substantial backlogs extending several years into the new century.

Prospects for the future

The U.S. shipbuilder has little hope of regaining a foothold in building commercial ships for the worldwide market. Although most observers expect increasing demand for new ships, worldwide, for at least the next several years, worldwide shipbuilding capacity is also increasing. The OECD predicts that by 2005, shipyards, worldwide, will have the capacity to build 40 percent more ships than will be ordered. Given these circumstances, it is not surprising that the world's major shipbuilders are not making a profit. Kvaerner, once the world's third largest shipbuilder, decided a few years ago to exit the market. However, that hasn't helped with the problem of over capacity because its policy was to continue operating its shipyards until buyers were found. No buyers have been found for their three largest yards, and Kvaerner (now Aker Kvaerner) has opted to continue to operate them, albeit unprofitably. Japan and Korea are reported to be nervously eyeing China and are engaged in a round of consolidation designed to make them more competitive.

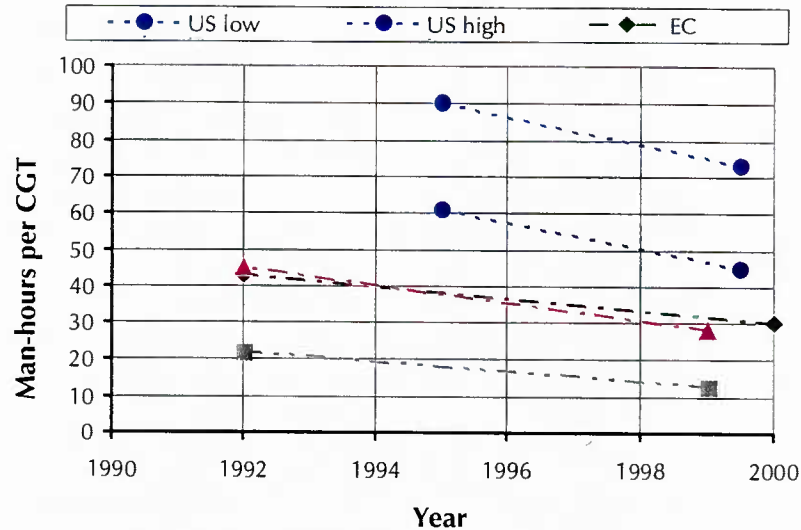
Figure 2 shows labor cost rates (wages plus benefits) for several major shipbuilding nations converted to dollars based on U.S. Bureau of Labor Statistics data for several recent years. Hourly wage rates for U.S. shipbuilding are not particularly high. In fact, labor cost rates for shipbuilding in several countries are as high as U.S. rates; and in Japan and Germany, which both have relatively strong shipbuilding industries, the rates in recent years have been higher than U.S. rates. Japan was the leading shipbuilder during much of the period covered by the chart. However, the most recently reported labor rates for Korea, which has become the world's leading shipbuilder, were substantially lower, partly as a result of the decline of the won.

Figure 2. Relative shipbuilding labor rates



U.S. shipbuilders use more hours, many more hours, than the better foreign shipbuilders. Several studies, over several years, have reported lower productivity for U.S. shipbuilding. Figure 3 displays relative productivity measures for large shipyards reported by First Marine International (FMI) in the Benchmarking study sponsored by the National Shipbuilding Research Program Executive Control board. A range of values is given for U.S. shipbuilders. The report shows that a U.S. shipbuilder in the middle of the range uses about twice as many hours as builders in Europe. The productivity reported for Korea is similar to that reported for Europe. The report shows that a U.S. shipbuilder in the middle of the range reported for the United States uses over four times as many hours as builders in Japan. The situation isn't much better if we compare the best-reported U.S. productivity rates. The report also shows that while productivity in U.S. shipbuilding has been improving in recent years, productivity in the leading shipbuilding nations has been improving at a faster rate. As a result, not only is the United States not catching up, it is actually falling further behind. The labor cost for building U.S. ships is higher because we use lots more labor.

Figure 3. Relative productivity rates



The big differences in the numbers of ships being built in Korea and Japan, where a shipyard builds about 50 commercial ships a year, and the numbers being built in the United States, where a shipyard builds one or two commercial ships a year, have important consequences. Most changes that are proposed to increase productivity require some expenditure to undertake and so will be undertaken only if the expected payback is greater than the expected expense. Many changes that would have sufficient payback over a series of many ships will not have sufficient payback for one or two ships and so should not be undertaken by a properly managed U.S. shipbuilder. Also, fixed cost associated with maintaining facilities and the firm are spread over many ships instead of only a few. Learning effects can be important. One U.S. shipyard reported that building the first vessel of a type requires about three times as many labor hours as the final three (of 30 vessels), about a 67-percent reduction. The biggest gains due to learning usually come at the start of a series, but the numbers of commercial ships now being built in the United States are so small that there is little opportunity to learn, and because builders can't expect to build a series, we are forced to wonder whether there are normal learning effects. In recent years, the large yards have sometimes

demonstrated reverse learning, with consecutive ships in a long series actually increasing in cost. Although learning-curve effects apply to building the same thing over and over, there will also be "learning transfer" from building something that is similar to things previously built. When the Korean shipyard starts to build a new type of ship, it will probably be similar to other ships they have recently built, and they will be able to transfer some learning to this new type of ship. There is little chance that a U.S. yard will have recently built any ships that are similar to a new type being considered.

Being large also provides important advantages in dealing with suppliers. For example, the largest Korean shipbuilder, Hyundai Heavy Industries (HHI), operates 9 large building docks and builds 70 to 80 large commercial ships a year yielding annual revenue of about \$6 billion. It has firm contracts for about 200 ships representing close to 3 years of work. Each year, HHI buys about \$4 billion worth of goods from suppliers. This level of purchasing activity gives leverage over suppliers because it means their suppliers are also booked for about 3 years ahead. HHI and their suppliers can plan ahead and optimize manufacturing operations to achieve unusually low costs. The downside of the suppliers' good fortune is that much of the savings will have to be passed to the shipbuilder.

Comparing the Korean and Japanese shipbuilding operations to those of the United States (and European countries) is, in some respects, like comparing a builder of tract homes to a builder of custom homes. The custom homebuilder can usefully adopt some of the techniques for increasing productivity that are employed by builders of tract homes, but not all of them. Being organized like the custom builder provides certain advantages for building unusual or one-of-a-kind homes. So both types of builders, with their different organizations and cost structures, can co-exist in the housing market. The relative sizes of the two sectors of the market will depend on both demand and cost factors.

With the exception of U.S. companies, shipbuilders in recent years have shown very little profit. Table 1 compares profits for large companies that build large ships. From available information, we extracted that which was most closely related to shipbuilding.

Ownership of some of the shipbuilding operations changed during the time interval so we have adjusted to represent net sales and operating margin in each year as if they were organized like they are now. Net sales for U.S. firms are in U.S. dollars, for European firms in Euro, and for Japanese firms in Yen. We don't list similar information for Korean shipbuilding companies because reliable information is not available. In recent years, the large Korean shipbuilding companies seemed to have incurred astonishing losses and accumulated extraordinary levels of debt that resulted in bailouts by the Korean government. Then, in turn, the International Monetary Fund and the international banking industry rescued the Korean government and banking industry.

Table 1. Shipbuilder profits in recent years

Groups of firms/years	Net sales and percent operating margin				
	1996	1997	1998	1999	2000
U.S. shipbuilding Units ^a					
Nets Sales (in millions of \$)	5,781	5,527	5,692	5,663	6,355
Percent operating margin	8.5%	6.8%	10.4%	11.3%	11.2%
European shipbuilding units ^b					
Net sales (in millions of \$)	4,426	4,634	5,275	5,890	5,909
Percent operating margin	7.2%	5.6%	1.5%	0.3%	0.0%
Japanese shipbuilding units ^c					
Net sales (in millions of \$)	1,799,605	2,029,691	1,973,840	1,990,927	1,419,688
Percent operating margin	2.7%	3.7%	1.6%	1.3%	0.5%

Financial results based on available data for the shipbuilding units of the major shipbuilding Corporations

a. For what are now the shipbuilding units of General Dynamics and Northrop Grumman.

b. For what are now the shipbuilding units of Alstom, Fincantieri, Kvaerner, & A.P. Moller not IZAR.

c. For what are now the shipbuilding units of Hitachi, IHI, Kawasaki, Mitsubishi, Mitsui, NKK, and Sumitomo.

There are some important things to learn from this brief history. First, we see that the current situation is not a new problem. It developed over many decades, and U.S. shipbuilders have not been competitive with the world-class builders of commercial ships for many years. It is also important to realize that the shipbuilding industries in many European nations have experienced and now face problems very

much like those facing the United States. We don't need to try the same things they have already tried without success. One basis for expecting the U.S. commercial shipbuilding industry to continue is the size of the Jones Act market. The "Jones Act market" refers to the market created by laws that require passengers and cargo being carried between U.S. ports to be carried on U.S. built ships. Our geography is such that some ships will almost certainly be used for transport between U.S. ports, so while current laws remain in effect, there will continue to be a market for some large U.S. built merchant ships. Perhaps U.S. shipbuilders should forget about trying to be internationally competitive and concentrate on serving the domestic markets as efficiently as possible so that we don't lose those as well.

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